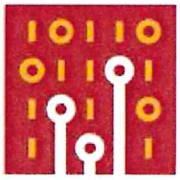

Computer History Museum

WHITE PAPER
for the
FINAL PERFORMANCE REPORT
PF-249653-16

Improvement Plan for the Long-Term Preservation of Computer History Museum Collections

Project Director: Karen Kroslowitz
Grantee: Computer History Museum
Submitted: September 6, 2018

Any views, findings, conclusions, or recommendations, expressed in this paper do not necessarily represent those of the National Endowment for the Humanities.

Introduction

Home to the largest international collection of computing artifacts in the world, the Computer History Museum (CHM) explores how the history of computing has impacted society. Through the use of rare and unique computer hardware and ephemera, software, still and moving images, a wide array of documents, and pioneer oral histories collected from around the globe, the Museum tells the stories of how computing has affected the ways in which we live, work and play.

Managing the care of the Computer History Museum's highly contemporaneous collection is not without its challenges. Collecting and preserving computer artifacts—mostly defense-inspired systems and consumer goods intended for short-term use and eventual disposal—is a relatively recent effort within the museum field. Yet, the scope, size, and nature of computer technology artifacts are vast. Additionally, from hardware to software media, the broad range of plastic formulations and other materials used in manufacturing—and the sheer number of manufacturers—changes rapidly, making it impossible for collections stewards to research and manage such detail and provenance. Most certainly, traditional preservation practices are suitable for CHM's paper- and film-based archives. However, the conventional practices for care and restoration to which the Museum's collections stewards are attempting to adhere may be considerably out of date.

The unique needs of CHM's modern 3D composite objects and ephemera deserve to be recognized by professional conservators. As conservators Odile Madden and Tom Learner of The Getty Conservation Institute discussed in *Preserving Plastics: An Evolving Material, a Maturing Profession*, conservation studies focused on plastics are rudimentary at best; that includes published general guidelines for storage environments.[1] In the same newsletter from The Getty Conservation Institute, an interview between art and design conservators discussing issues in plastics conservation nodded to the yellowing of an Apple Macintosh case (as an artifact of design).[2] It is a spark of recognition among conservators that, beyond just thinking about plastics, modern technology artifact collections have unique requirements of their own that may challenge the long-held accepted norms for conservation and restoration.

[1] Madden, O., & Learner, T. (2014, Spring). Preserving Plastics: An Evolving Material, a Maturing Profession. *The Getty Conservation Institute Newsletter*, *29*, 4-9. Retrieved August 7, 2018, from https://www.getty.edu/conservation/publications_resources/newsletters/pdf/v29n1.pdf

[2] Levin, J. & Learner, T. (2014, Spring). The Material of Possibilities: A Discussion about the Conservation of Plastics. *The Getty Conservation Institute Newsletter*, *29*, 4-9. Retrieved August 7, 2018, from https://www.getty.edu/conservation/publications_resources/newsletters/pdf/v29n1.pdf

Those conventional norms are also likely out of synch with burgeoning interests, by visitors and funders, in seeing demonstrated restored systems. Today's emerging conservators will need to consider a broader, more practical approach to conservation: using replacement parts and a "re-treatability" approach in *restorations* versus the time-honored "reversibility" methods of strict *conservation*, particularly as collections stewards struggle against the inherent vices of plastics. CHM is willing to collaborate with, as a platform and partner, the new wave of conservation professionals who show interest specific to plastics and technology. Unfortunately, consulting conservators specializing in computer preservation and restoration are rare and CHM has never employed a staff conservator. Hopefully, a new wave of conservation professionals with interests specific to plastics and technology will emerge.

Project Activities

With thanks to the National Endowment for the Humanities' Sustaining Cultural Heritage Collections Planning Grant, the Museum was awarded $40,000 for its project *Improvement Plan for the Long-Term Preservation of Computer History Museum Collections*. With assistance from artifact conservation and museum environment specialists, the intent was to investigate hardware and ephemera collections preservation challenges by examining operations at the Museum's public exhibitions and programs facility ("Shoreline" in Mountain View, CA) and in storage at its warehouse ("Yosemite" in Milpitas, CA) in order to identify areas for improvement.[3] The result would be two specialized reports—one focusing on preservation practices, the other on environment and climate—with recommendations to be addressed through ongoing collaborations between CHM Collections or Facilities staff. Further, the process was also a means for increasing awareness and encouraging broader communications across the Collections and Facilities departments as assessments were performed. The project itself was not without its challenges: several changes to key personnel, which required an extension.

A few months following proposal submittal, the author and project director left the Computer History Museum. NEH supported naming the new Senior Registrar as replacement project director. Following the press release announcing the award, she initiated communications with project team members, established a Google Drive account for data and document sharing, finalized contracts and scheduled site visits.

It was learned that proposed conservator Dr. Nora Eibisch, a recent immigrant from Germany who specializes in technology and mechanical artifacts restoration, had not yet been granted an official work visa as expected. This barred her employment in the U.S. and risked her involvement in the project. Losing Eibisch's expertise would result in a significant loss to the project. Local art and objects conservator John Burke, highly regarded within the conservation community for his breadth of knowledge, was identified as a possible replacement. As the retired Director of Collections and Chief Conservator for the Oakland Museum of California (1982-2011) and former faculty professor for John F. Kennedy University's graduate-level

[3] In 2014-2015, CHM underwent a similar assessment primarily focused on its archival holdings. Thus, only the hardware and ephemera collections were the focus of this assessment.

preventive conservation classes, Burke had facilitated numerous grants over his career and remained active with the American Institute of Conservation (AIC) and the Bay Area Art Conservation Guild (BAACG). Following discussions regarding Eibisch and Burke, NEH generously granted permission in November 2016 to bring Burke on as the paid conservator while keeping Eibisch engaged as an unpaid volunteer. As a recent Ph.D. graduate of the Technische Universität München in Munich, Germany, this arrangement gave Eibisch the opportunity to collaborate with and be mentored by Burke, a seasoned professional. This "two-for-one" arrangement at no additional cost to either NEH or CHM greatly strengthened the project.

The project team comprised of the Project Director, conservators Eibisch and Burke, and museum environmental consultant William P. Lull then settled their approach to onsite testing for lighting, air quality, and operational practices of the mechanical systems. The conservators immediately launched their initial surveys in November and December 2016 in keeping with the project timeline. Of particular interest was to determine the levels of off-gassing from different plastic-based artifacts and from the exhibit cases or storage materials themselves. Volatile organic compounds (VOCs), which are hazardous to human health and agents of artifact degradation, are found in all plastics. Thus, VOCs should be expected to be higher in a collection like CHM's than in other "typical" historical artifact collections. To measure ambient presence of VOCs, 3M model 3500 passive vapor diffusion monitors were deployed at Shoreline and Yosemite. In January 2017, the Project Director and Eibisch also placed acetate deterioration (A-D) test strips to detect general acidic pollutants in exhibit cases, along with Gastec dosimeter tubes to detect off-gassing acids, most notably acetic acid. An initial rough draft of the conservators' findings and further questions was shared with team members in early January 2017.

Concurrently, Lull reviewed energy statements for Shoreline and Yosemite—dramatically different in size, construction and operations—as a first step towards investigating energy efficiency and improvement options. At 119,000 sq ft, Shoreline is the Museum's main exhibitions and public programs facility, constructed in 1993 of concrete, steel and glass. The "vault-like" Yosemite is a 24,000 sq ft high-ceilinged industrial warehouse with pre-fabricated cement panel exterior, concrete flooring and skylights, constructed in 2001. Interior walls and ceiling are insulated with plastic-encased thermal insulation batting, added by CHM prior to occupancy in 2007, and outfitted with high-bay pallet racks and industrial steel shelving.

In February 2017 an expanded team gathered for a week of site visits to Shoreline and Yosemite. They inspected the interiors and exteriors of both facilities, including surrounding grounds and landscaping; building envelopes; rooftops; mechanical HVAC systems; operations, occupancy, access and security points; climate; lighting and window dressings; gallery design and exhibit case materials. Consultants met and asked questions of Director of Operations Jennifer Alexander and Facilities Coordinator Luis Valencia, along with various CHM registrars and archivists working in the two spaces regarding operations and practices. Additionally, Lull took light readings and real-time measurements for quantitative levels of particulates using a clean-room grade MET ONE 227A/227B handheld airborne particle counter. He also

investigated the possibility that recently installed mobile compact shelving for the media archive had become magnetized, which could endanger the readability of magnetic tapes.[4]

As the week closed, the Project Director, Burke, Eibisch and Lull were joined by Alexander, Corey Williamson of Air Systems, Inc.—the Museum's vendor for HVAC systems—plus VP Operations Gary Matsushita (absent: VP Collections & Exhibitions Kirsten Tashev and Director of Collections Karen Kroslowitz) for a plenary discussion to pose additional questions, raise specific concerns and capture initial conclusions. Four issues were of particular environmental concern: malfunctioning economizers in the AC units at Shoreline; compromised building envelopes; extremes in lighting, windows and skylights; and particulate pollution. Conservators also made note of the choice of exhibit case materials and design choices; lack of boxing and coverings for large artifacts in storage; need for improved security and integrated pest management (IPM) measures; and the need for a staff conservator.

Follow-up testing and analyses were conducted in March, including deploying six HOBO data loggers and closing all economizers in the main museum and in storage for thirty days. Logged data would reveal the impact of overnight outside air intake on temperature and relative humidity as compared to historic data and Lull intended to determine whether reducing economizer use would significantly reduce in-gallery climate fluctuations and how the practice might impact overall costs.

In May 2017 the Project Director left the Museum following a prolonged leave. Having served the Museum since 2007, Director of Collections Karen Kroslowitz officially assumed the role of project director which provided sustained knowledge about the scope, history and care of the collection as well as insight into institutional strategic goals and funding. Concurrently in spring 2017, environmental consultant William Lull experienced a prolonged personal matter which compromised his ability to deliver a report as scheduled. Lull was eventually released from his commitment in August. NEH graciously granted the Museum a one-year extension of the award period in order to identify a replacement and complete the project as intended.

In November 2017 museum environment consultant Jeremy Linden joined the project team. Formerly a preservation specialist with the Image Permanence Institute, Linden reviewed the report completed by Burke and Eibisch, along with climate readings and other previously gathered data. Burke assisted in familiarizing Linden to the project via a phone conversation. Hosted by Director of Collections Karen Kroslowitz with Director of Operations Jennifer Alexander, Linden visited CHM for four days in December 2017. They concluded by meeting with Burke and team member Roel Mallari of Air Systems, Inc. (absent: Matsushita and Tashev) for a discussion of Linden's findings. Linden's assessment focused on the aging HVAC system, weaknesses in building envelopes, and uneven lighting in both facilities as a probable source of heat load and artifact vice. Linden and Kroslowitz continued communications regarding data throughout spring 2018. In keeping with the timeline Linden provided his report in June 2018.

[4] Further testing with a Gauss meter revealed the shelving was not magnetized but that the motors may have interfered with Lull's compass.

Accomplishments

The *Improvement Plan* project accomplished its primary goal: specific reports focusing on preservation practices and environmental systems with recommendations for future improvements. Less was learned about the care of plastics and technology; the reports focused more on strengthening general best practices fundamental to good collections care. For example, Collections staff learned about additional resources for understanding plastics degradation and revised climate parameters for exhibits and storage. Most notably, the project also greatly improved awareness among Facilities staff and air system contractors regarding the unique preservation requirements for museum artifact collections (as compared to typical office or retail facilities). By the same token, Collections staff has a better understanding of how the HVAC mechanical systems function, the scope of the work required for upgrades or unit replacements and how those efforts will need to be tied to future major capital improvement endeavors due to the extensive scope of the work. Additionally, the many discussions about audience expectations of restorations and demonstrations provided the conservators with considerable food for thought.

The *Improvement Plan* was designed as an opportunity to lay the groundwork for implementation of future projects based on evidence and resulting report recommendations. Baseline goals and projects are now established, across cost ranges for environmental conditions that consider energy-efficiency and current mechanical system capabilities with both human comfort and artifact storage and exhibition requirements in mind. Serendipitous to the project extension, CHM welcomed new President & CEO Dan'l Lewin in March 2018. Lewin invited staff to participate in an organizational review to gather collective input related to CHM's mission, goals, funding and, of most relevance to this planning project, major facilities needs and upgrades. This planning project's focus on assessment and improvements across the Museum will help inform a ten-year long range plan (LRP) for improving CHM's facilities. The LRP is currently being developed by CHM's VP of Operations and project team member Matsushita with significant input from staff from across all departments and guidance from Lewin and board trustees.

Thus, the timing is right for a future team, composed of CHM collections and operations staff and a building engineer (per one of Linden's recommendations), to collaborate to:

- Evaluate the construction of and recommend specific improvements needed for building envelopes, such as repairing window seals and adding insulation where possible.
- Further enact passive and active methods to improve climate control and energy efficiency of the current HVAC systems while identifying future needs and costs for upgrades or replacements.

As an intermediate step towards improving preservation practices, Collections and Facilities staff began tackling some of the no-cost or low-cost measures as the project entered its second year. Efforts include improving seals on all doors at both facilities, replacing HVAC filters with MERV filters rated for museum conditions, anticipating seasonal pest management issues by scheduling quarterly pest control treatments, and identifying ways to be more energy efficient

by adjusting exhibition lighting. Registrars have also completely transitioned to using only PEM2 loggers and there is now a division of labor between registrars for monitoring facilities-related issues (climate, IPM, other risk factors) across the three buildings. The existing Collections-Facilities-IT committee has added members to widen topics discussed and broaden knowledge across the institution.

Audiences

The *Improvement Plan* was launched to evaluate CHM's unique facilities and operations as they affect its collection. The *Plan's* findings were meant solely for internal distribution to CHM staff, board members and contractors. Although suggested by the proposal author, no widespread solutions or recommendations can be made to the museum community regarding the preservation of computer artifacts or plastics in general. As originally envisioned, this *planning* project was never intended to investigate, analyze or result in such specific findings. Only long-term studies can achieve such goals. However, the consultants involved in this project did utilize their experiences at CHM to reach out and educate the broader museum community.

Dr. Eibisch's presence and professional interests in CHM's collections led her to interact with CHM's volunteer restoration teams, with whom she collaborated about the ongoing DEC PDP-1 and IBM 1401 demonstrated systems. As a result, she influenced and edited the content of a paper about restoring vintage mainframe systems presented by IBM 1401 volunteer Robert Garner at the UK Computer Conservation Society in historic Bletchley Park outside London, in May 2017.

Just prior, in April 2017, Dr. Nora Eibisch presented *From Paintings to Computers. What do we preserve?* at the Living Computer Museum+Lab in Seattle, WA as part of its *PreserveIT!* event for conservators and the general public. Eibisch discussed how traditional restoration views and practices may not be appropriate for technology artifacts. She especially noted that audiences for these recent artifacts of contemporaneous history have vastly different visitor expectations, including a keen interest in preserving technical detail while also reveling in the joy of seeing these tools operate. Thus, professional conservators have vastly different issues and resources to consider. A video of her talk can be viewed at LCM+L's Facebook page.[5]

Dr. Eibisch later offered another presentation entitled *The Challenges of Preserving Modern Tech* to about twenty-five Bay Area Arts and Conservation Guild members and CHM staff and volunteers at the Computer History Museum in May 2017 during a day-long session entitled *Ghost in the Machine*. John Burke followed her presentation with his own, "The Ghost in the Machine: thoughts about the preservation of electronic systems and data," which included a brief overview of conservation practices and the role of museum information management. In particular, he noted the importance of preserving data/metadata (as "cultural DNA") and recommended that collections stewards prepare for and guard against "double-fold" information loss, recommending the use of semantic markup and other data migration

[5] Living Computer Museum+Lab *PreserveIT!* <https://www.facebook.com/LivingComputers/videos/1330043237079896>, accessed June 20, 2018.

strategies to protect against the loss of digital or digitized data. In April 2018, Burke was invited to present the same talk for an audience of twenty-five staff from conservation, registration, library and technology departments at the National Palace Museum in Taipei, Taiwan.

In partnership with the American Institute for Conservation's Emergency Committee, Jeremy Linden hosted two webinars on managing moisture.[6] Nearly all of CHM's registrars and archivists (eight staff total) attended both sessions, which noted issues particular or similar to those Linden had evaluated at CHM. Staff found the information and principals outlined in the webinars to be accessible and helpful towards their understanding of mechanical systems and data logging and analysis, particularly as they help plan for a near-future expansion of CHM's archives facility and anticipate disruptions in artifact storage and exhibits.

Evaluation

While the *Improvement Plan* project was not formally evaluated, those involved feel it achieved desired goals. Despite personnel changes and delays, many of the issues identified during site visits and further developed during plenary discussions were addressed quickly, and several low-cost recommendations were instituted prior to delivery of the formal reports. The project's main strength was the sincere collective interest in improving stewardship practices at the Museum and frequent communications, primarily through phone calls, e-mails and use of a shared cloud account. Through the meetings and discussions held during the project CHM strengthened its partnership with HVAC design firm Air Systems, which will serve the Museum well in the future as it considers system upgrades. Understandably, the project required a deep professional knowledge of the Museum's history, the collection and an understanding of long-range strategic goals. Occasional misperceptions early in the program, due to the newness of the project director as a CHM employee, were later identified and ironed out by Kroslowitz as the reports were reviewed.

Continuation and Long-term Impact

As it relates to major capital improvements (HVAC system upgrades), the *Improvement Plan* will evolve. With the project consultants' recommendations and using references from the American Alliance for Museums, the project will be furthered through the near-future development of the Museum's Facilities Long Range Plan (F-LRP), to be fully developed in FY2019, and a long-range Collections Stewardship Plan (CSP).[7] The Museum did not attempt to attract additional non-federal financial support, for the project or for activities yet-to-be borne from the project. However, executing on the aforementioned plans will require significant financial support and it is hoped that private donors especially will be encouraged by CHM's demonstrated interest in responsible, energy-efficient operations. As part of any possible

[6] Linden, J., *Managing Moisture in Non-mechanized Environments and Disaster Situations* (July 31, 2018), <https://youtu.be/RK4fFFt4i0I> and *Mechanical Control of Moisture in Cultural Heritage Settings.* (August 21, 2018) <https://youtu.be/p7H9nzwztH0>.

[7] Staff will use references such as Sherelyn Ogden's *Preservation Planning: Guidelines for Writing a Long-Range Plan (AAM, 1997)* and guidelines and sample collections and conservation plans available at the AAM website.

future fundraising campaign, CHM would pursue a combination of private support and government grants to fund the most extensive and expensive of project recommendations. CHM is currently reviewing the guidelines for NEH's Sustaining Cultural Heritage Collections Implementation Grant; IMLS's Museums for America program; and the California Cultural & Historical Endowment grant from the California State Department of Natural Resources.

Products

As previously mentioned, several reports and presentations were created as a result of this project:

- Computer History Museum (2016, August 15). *Computer History Museum Awarded National Endowment for the Humanities Grant for Creating Long-Term Artifact Sustainability* [Press release]. Retrieved August 16, 2016, from http://www.computerhistory.org/press/neh-2016.html
- Eibisch, Nora and John Burke (2017), *Computer History Museum NEH Conservation Assessment*. Unpublished report.
- Linden, Jeremy. (2018). *Preservation Environment and Mechanical System Assessment, Computer History Museum*. Unpublished report.
- Eibisch, Nora (2017, April 28), *From Paintings to Computers. What do we preserve?*, PowerPoint slides presented at PreserveIT! at the Living Computer Museum+Lab, Seattle, WA . https://www.facebook.com/LivingComputers/videos/1330043237079896
- Eibisch, Nora (2017, May 13), *The Challenges of Preserving Modern Tech*, PowerPoint slides presented at Bay Area Art Conservation Guild annual meeting, Computer History Museum, Mountain View, CA.
- Burke, John (2017, May 13), *The Ghost in the Machine: thoughts about the preservation of electronic systems and data*, PowerPoint slides presented at Bay Area Art Conservation Guild annual meeting, Computer History Museum, Mountain View, CA.
- Burke, John (2018, April 23), *The Ghost in the Machine: thoughts about the preservation of electronic systems and data*, PowerPoint slides presented at National Palace Museum, Taipei, Taiwan.
- Garner, Robert (2017, May), *Restoring and Exhibiting 1960s Vintage Computers at the Computer History Museum*, Unpublished paper presented at UK Computer Conservation Society meeting, Bletchley Park, London, UK.
- Eibisch, Nora (2017). *Artifact Packing: The Basics*. Unpublished guidelines.
- Computer History Museum, *Long-Range Plan for Computer History Museum Facilities*. Email thread and outline for task force members regarding the work in progress, dated July 26, 2018 (23 pages of consolidated comments from working groups not included).